

HIGH PERFORMANCE POLYMER PROTECTS AUTO RACING SPECTATORS FROM FLYING DEBRIS





Payoff

Polybenzobisoxazole (PBO) fiber, a high performance polymer, has uses in both military and commercial applications. Primary examples of military applications include its use as a ballistic jacket on the outside of pressure vessels, such as helium tanks on satellites, and for flak vests in body armor. The Federal Aviation Administration (FAA) is currently examining PBO for use as a flame-resistant protective cloth between the cabin and the outer fuselage of aircraft to guard against engine shrapnel. Other commercial applications include insulating belts for high temperature industrial grinders and in protective clothing for fire fighters and other individuals requiring protection from heat and flames.

Accomplishment

A high performance polymer developed at the Materials and Manufacturing Directorate (ML), using Air Force Office of Scientific Research (AFOSR) funding during the 1960s and 1970s, is being used to make tethers that keep tires and wheel assemblies attached to racecars when they crash. PBO helps protect drivers and spectators from injury and death when wheel components fly out of control at major racing events such as the "Indianapolis 500." Originally developed for high temperature aerospace applications such as flame retardant flight suits and aircraft seat covers, PBO is part of a family of polymers known for their flame and abrasion resistance and outstanding tensile mechanical properties. PBO is now being used in a wide variety of commercial products including tires, belts, hoses, plastics, concrete, cords, gaskets, abrasive materials, heat and flame resistant clothing, ballistic flak vests, cut and abrasion resistant safety gloves and protective clothing for firefighters.

Background

Following PBO's development at ML, processing technology research continued for nearly 20 years before reproducible polymer products could be fabricated. Brunswick Defense Co., now Lincoln Composites of Lincoln, NE, used an impregnated PBO composite over a thin aluminum liner to replace the graphite fiber in compressed natural gas storage vessels. They also sought to develop these fibers for self-contained breathing apparatus for firefighters, gas containers for inflating car airbags, aircraft emergency exit escape slides and alternative fuels containers for environmentally compliant transportation vehicles. Dow Chemical Company commercialized the technology and later partnered with Toyobo Co. Ltd., a 120-year old fiber-producing firm in Japan, which expanded PBO's application under the commercial name ZylonTM to several product lines, including that used in the safety tethers for racing cars. Known as the "Safety Wheel Energy Management System" (SWEMS), the safety tether system is designed to keep tires and wheel assemblies attached to the car in the event of an accident. PBO has a tensile strength of 800,000 pounds per square inch, about twice the tensile strength of glass optical fibers and strong enough to be used in ballistic flak jackets. PBO fiber can withstand temperatures up to 600 degrees C, the temperature found in the hotter areas of typical flames.

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